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THE U.S. AUTOMOBILE INDUSTRY: WILL IT SURVIVE INCREASING INTERNATIONAL COMPETITION?

BY

COLONEL GEORGE J. BROWN
United States Army

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THE U.S. AUTOMOBILE INDUSTRY: WILL IT SURVIVE INCREASING INTERNATIONAL COMPETITION? AN INDIVIDUAL STUDY PROJECT

by

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ABSTRACT

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The U.S. automobile industry is a vital basic manufacturing industry. In the past 25 years the U.S. auto industry has fallen on hard times because of increasing foreign competition. Prior to 1980, the auto industry provided 1 in every 6 non-government jobs. The U.S. was a revered exporter of automobiles and related technologies. Today, imported automobiles claim almost a third of the domestic market share and government legislation is in place attempting to preserve the industry. The decline of the auto industry mirrors the erosion of manufacturing in the U.S. in general. Deterioration of the U.S. machine tool industry shares its roots with the auto industry. The auto and machine tool industries are critical elements of America's strategic capabilities. Both the machine tool and auto industries were vital to mobilization efforts during major armed conflicts. Loss of these industries will inhibit the nation's ability to convert new technologies into defense related and commercial commodities. The reasons for the decline of American manufacturing have been extensively studied. Solutions have been proposed, some have been implemented. Varying progress has been achieved with American plants being more efficient producing products that are better. Challenges remain however, particularly for weaker firms.

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I. Introduction

United States automobile production is a vital basic manufacturing industry, a bellwether of the American economy, and a measure of our national capability. Prior to 1980 the automobile industry provided 1 of every 6 jobs in the United States. Twenty five years ago, imported passenger cars were less than 6% of the total U.S. market. Today the foreign share of the U.S. market approaches 30%. In July 1990, the best selling automobile in the country by almost a 2:1 margin was the Japanese designed Honda Accord.¹ It has been estimated that since 1980 over a quarter of a million automobile and related basic manufacturing jobs have been lost.² What happened?

In 1967 the United States enjoyed an auto export surplus. Last year the auto import deficit was \$60 billion and the largest single element of the overall U.S. trade deficit. American automobile production used to be the greatest in the world. Automobile production in the United States now places third in the world: Japan builds more cars and Europe buys and builds more cars than the U.S.³

Explanations for the decline of America's basic industries have come from many sectors of our society. Auto industry executives complained that the major competitive threat was from "Japan Incorporated." A contention was that Japanese labor costs were lower than those in the U.S. James Harvard, a former Chrysler Corporation

engineer, calculated the labor cost disadvantage to result in a \$1500-2000 per car advantage for Japanese manufacturers. Harvard's figures were accepted and echoed without complete scrutiny.⁴

Lee Iacocca, Chrysler Corporation's Chairman, has said that perhaps a greater threat to the domestic auto industry was the Japanese Ministry of International Trade and Industry (MITI). Iacocca maintained that the Japanese auto industry has a powerful partner in MITI. His contention is that MITI's mission is to determine the industries most critical to Japan's future and to help finance research and development. In Iacocca's view, MITI is one of the most prestigious areas within the Japanese government. The "best and the brightest" are attracted to MITI with incredible impact on Japanese industry. To rebuild Japan after the war, MITI targeted the auto, steel, chemical, shipbuilding, and machinery manufacturing as critical industries. Lee Iacocca: "Japan's economic destiny was not left up to the free play of laissez-faire economics."⁵

When Lee Iacocca was asked in a recent interview what went wrong with the U.S. automobile industry and who was to blame. Iacocca replied:

We're all at fault, I guess for going astray. You can't point fingers. We must have done something wrong - our industrial policy is in disarray. The Government, the unions and the management - I give them all one third of the blame. That includes me on the management side. But to have these (Japanese) second-guessers pointing fingers and saying that because they've got their house in order economically, that makes them a superior race - well, I just don't buy that shit. I never will.⁶

By 1983 it was quite clear that America's basic manufacturing industries were in decline. Steel imports increased 300% since 1967 and auto imports by 700%. U.S. industry exports had declined from 22% of the world market in 1963 to 12%. The United States had the lowest rate of productivity increase of any non-communist country.⁷ U.S. plants were on average 6-10 years older than manufacturing facilities and equipment used by its competitors. American plants require approximately 40% more labor to manufacture automobiles with twice as many defects as their Japanese equivalents.⁸ Scores of manufacturing plants permanently closed forcing a quarter of a million Americans out of work.⁹

The automobile industry in particular and most industries in general are dependent on the machine tool industry to supply metal working tools. The U.S. machine tool industry which enjoyed a healthy trade surplus in the early 1960's is disintegrating. In the 20 plus years from 1964 to 1986, the U.S. machine tool industry has gone from a net exporter to having its domestic market share reduced to less than 50%. The U. S. machine tool industry produces less than half of what it did during peak production years two decades earlier.¹⁰ Machine tools that bend, cut and shape metal are vital to the technological revolution that is taking place. The decline of this industry in America may have profound implications for the nation's defense industrial base and its ability to mobilize for war.

The "Japan-Incorporated" arguments and the national fear of the

failure of America's tenth largest corporation resulted in the government bailout of the Chrysler Corporation. Chrysler's rising from the ashes of 1979 is history. The decade of the 1990's promises to be no less internationally competitive than previous times. What lessons have we learned? Have we made the required changes in these vital industries? Why is Chrysler Corporation in trouble again in 1991? Were the arguments presented to save the American auto industry accurate? What is the health of our automobile and machine tool industries today? Can we compete in the international market place? Will the United States be able to depend on its domestic industries for full war mobilization in the future if necessary?

I will attempt to analyze and answer these questions through a brief survey of the history of the U.S. automobile industry and examination of the contributions the industry made to U.S. war efforts. I will compare the American automobile industry to its foreign competitors, take a look at the strategies used by Chrysler, Ford and General Motors to transition from the post World War II period through the 1973 oil crisis to the present, and examine the effects of congressional legislation intended to protect domestic industries.

The economic consequences of industrial decline in the United States has and will continue to have a major impact on the living standard of the average American. Equally important, the economic and political fortunes of the United States may be inextricably linked to its manufacturing capabilities. The power and prestige of America may

ultimately be contingent on the nation's ability to effectively compete in the international manufacturing marketplace.^{11, 12, 13}

Finally, I will propose recommendations for the future success of these vital industries and make a convincing argument for a cogent national industrial policy as an important facet of our national strategic planning process.

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II. History

There were about 500 automobile manufacturers in the U.S. in the early 1900s. These early cars were made of flat sheet steel over wooden reinforcements. The development of stamped steel construction over steel frames was a major advancement. This single change in technology required auto manufacturers to make major investments in tooling and machinery. The net result was that by 1927 the number of automobile companies in America was fewer than 50.¹

U.S. Auto Industry

In 1903 Henry Ford founded the Ford Motor Company. Ford was born on a farm in Dearborn Michigan to Irish immigrant parents. The Ford family was nearly penniless. Henry Ford was to become the nation's first billionaire. His formula for success was simple: "build a car for the average man, make more of them better and cheaper."²

The Ford Motor Company sold 1500 cars in its first 15 months of existence.³ In 1908 the first Model T was produced with a retail price of \$780.00. During the first phase of Model T production it took twelve and a half hours to produce a single auto. Ford constantly badgered his workers and engineers to think of ways to increase production efficiency. By the end of the first year of Model T production the construction time had been cut in half. Ford hired Walter Flanders, an industrial efficiency expert. Flanders was to be paid the unheard of sum of \$20,000 if he could get the plant to produce 10,000

Model T's in a year.⁴ It was Flanders who devised the "line" to assemble small components and met Ford's challenge with two days to spare. Another Ford production expert, Charles Sorensen had a Model T pulled across the factory floor by windlass while workers attached parts while the process was timed. Thus the "assembly line" was born.⁵

Ford lowered the price of the car from \$780 in 1910 to \$360 in 1914. By 1925, a Model T was rolling off the assembly line every 10 seconds. Ford Motor Company's market share grew from 9.4% in 1908 to a remarkable 48% in 1914, and 60% of the domestic market by 1921.⁶ In 1914 Ford Motor Company with 13,000 employees produced 267,720 cars. The other 299 American auto companies with 66,500 employees produced only 286,770 autos. The Ford Motor Company's net profit soared to \$6,000,000 monthly after taxes.⁷ About the same time that Ford was gaining market share vast new oil reserves were discovered in Texas assuring cheap energy for the burgeoning auto industry.

Henry Ford was to develop the largest, most comprehensive industrial facility the world had ever known, the Rouge River plant. The Rouge plant at its maturity in 1928 not only manufactured automobiles, but trucks, tractors, steel and glass. Rouge was a mile and a half long and three quarters of a mile wide. Its seventy five thousand workers could convert iron ore to finished product in a little less than 4 days. Henry Ford loved his plant and spared no expense in making

Rouge more and more efficient.

Unfortunately all was not well with the Rouge plant. Ford was always badgering his managers to extract more from the workers. The plant's workers had nicknamed Ford the "Speedup King." Work absences rose dramatically. In fact the Ford Motor Company had to keep almost a thousand men employed to get 380 to work. Henry Ford was a peculiar man. He was extremely puritanical and judgmental. He felt most of the evil in the world was done by people who smoked cigarettes and used alcohol. Ford began the Ford Sociology Department within the Rouge plant to check up on employees and see if they used alcohol at home and had union sympathies. If so, they were fired. The department was a means of spying on employees with personal, health and financial problems.⁸ Henry Ford cared little for his employees and frequently played cruel tricks on his management staff. Ford's labor practices steadily deteriorated. The Rouge plant became a symbol of oppression and a place of union struggle for workers' rights. Henry Ford was largely responsible for the adversarial relationship between management and labor in American industry.⁹

If Henry Ford loved his factories more than his workers, he loved the cars Ford Motor Company made even less. The Model T was produced without significant change from 1908 to 1928. Ford resisted any change on the part of his engineers and personally destroyed a prototype replacement car. Ford struggled with his son Edsel over the need for change and the introduction of product innovation. The net

result of Henry Ford's stubbornness was the emergence of General Motors and Chevrolet as the most popular automobile manufacturer in the U.S. Ford Motor Company's market share fell steadily from a high of 60% in 1921 to 20% by the beginning of World War II.¹⁰ By 1943 Ford Motor Company was near bankruptcy because of the policies of Henry Ford. The U.S. government was considering the takeover of Ford to maintain adequate production of war materiel. President Roosevelt relieved Henry Ford's grandson, Henry Ford II, from active duty service with the navy to head the struggling Ford Motor Company at the age of 28.

The conclusion of World War II in 1945 marked the end of the automobile industry and basic manufacturing capability in Germany and Japan. German and Japanese industrial plants lay in ruins. Billions of Marshall Plan dollars would soon provide seed money for rebuilding the industrial bases of former U.S. enemies. The requirement to rebuild plants and rethink manufacturing processes would play a role of inestimable value in developing industrial competitiveness in Germany and Japan.

While Ford was struggling with the aftermath of the ruinous policies of Henry Ford I, General Motors (GM) was prospering. Much of the early engineering talent that the Ford Motor company had employed defected to the competition. General Motors also prospered with the innovative genius of Charles F. Kettering a founder of the Dayton Engineering Laboratories Company which was to be acquired

by GM and subsequently be known as Delco-Remy.¹¹

Kettering invented such technological breakthroughs as the modern ignition system and the electric self starter. In the forties Mr. Kettering developed high octane ethyl lead gasoline and the modern high compression overhead valve engine.¹² These single developments propelled GM ahead of the competition worldwide. To help insure success, GM began the General Motors Acceptance Corporation (GMAC). GMAC was the first industry owned finance company that would allow potential auto customers a one stop place to buy and finance their automobiles.

GM was performing spectacularly in the market. Its performance was so exceptional that GM lawyers were concerned about possible anti-trust litigation. GM in the early 1950's had the largest share of the automobile market, the light and heavy truck markets and a virtual monopoly on buses. GM also made the majority of the nation's diesel electric rail locomotives and owned "Herz Drivurself" rental car company. GM was out front with the other automobile manufacturers trying to catch up.

Foreign Competition

The first Volkswagen "Beetle" reached American shores in late 1949. It was a design based on the chassis of the German army "kampfwagen" with a body that closely resembled the Chrysler Air-flow of 1934. Ford Motor Company executives considered purchasing Volkswagen after the war but considered its product unsuited to

American tastes. The attitude of American companies toward small economical foreign made cars was stated in a 1945 statement by the Automobile Manufacturers Association:

Manufacturers who have tried to compete with the used car market by offering a "stripped down" low-cost new car have fared badly. During the Depression, attempts to sell "standard" models in competition with "masters" and "deluxes" made little headway. Efforts to sell the European small car met with little success. People could get a full-sized car for less money. There has been little chance in this country of introducing a low-cost people's car, as Germany planned to do in the 1930s. We already have it. The used car is it.¹³

In 1948, W. Edwards Deming, a manufacturing consultant was invited to Japan to help its newly emerging auto industry. Deming was an advocate of quality manufacturing and had developed a system of quality control in manufacturing based on mathematics. Deming's principles were used by U.S. industry during WW II in bomber production with excellent results. After the war, Deming's methods were ignored by domestic automobile producers.

Nissan was the first Japanese company to employ Deming's methods. Over the next decade, the Deming quality control methods were adopted by most of Japanese industry. In fact the Japanese established a "Deming Award" for manufacturing excellence. Many Japanese industry experts on business trips to the U.S. were surprised to learn that their American counterparts knew little or nothing of Deming's work.¹⁴

From 1949 to 1959 the foreign share of the domestic automobile market grew from 0.3% to 10%.¹⁵ What was a nuisance to Detroit

became a threat. The American manufacturers began a campaign to produce "import fighters" such as the Ford Falcon, Chevrolet Corvair and the Plymouth Valiant. These initial "compact cars" were later followed by excellent entries from the GM "BOP" divisions: Buick, Oldsmobile and Pontiac. The autos from GM had many innovations and engineering firsts. They were good, practical and economical automobiles that sold well.

Ford was unable to spend the required capital to develop such cars. Recovering from the Edsel debacle left Ford cautious and under capitalized. In the early 1960s Lee Iacocca, then president of Ford, developed a sporty variant from the cheap to produce Falcon chassis. This new car used major mechanical subassemblies that were already in Ford's inventories. The only significant difference was that this car would be available with Ford's new lightweight modern V8 engine. The car was the Mustang. It was an overnight success. The Mustang arguably was the car that began the great horsepower race of the next decade. The domestic auto manufacturers' attention was now focused on "personal" or "pony" cars such as the Mustang and away from practical economic sedans. Besides, this type of automobile had low development costs and high profit margins.

GM joined in building and marketing Mustang type cars. Much of the innovation that was achieved in the BOP compacts was abandoned. These cars grew in size and horsepower almost yearly. The excellent all aluminum V8 developed by Buick and Oldsmobile for use

in the Skylark and F-85 compacts was sold to British Leyland (this engine is still being used in the \$40,000 Range Rover). American cars became larger, more powerful and fuel inefficient.

In 1970 the foreign car share of the domestic market was 14%. Foreign manufacturers were catering to that segment of the American public that wanted small well made efficient cars. The German Volkswagen "Beetle" was now being replaced by excellent little cars from Japan. The Datsun 510 was such a car as was the pickup version based on the 510 chassis.

Detroit's responses to the early 1970s import car threat were such ignominious creations as the Pinto and Vega. Both automobiles were seriously flawed. The Pinto was heavy, underpowered and would burst into flames in a rear end collision. The Vega was noisy, rust prone and its engine was poorly engineered with severe reliability problems. The follow-on Chevette, "X" cars and "J" cars were not much better.

The oil shortages of 1973, 1976 and the developing Environmental Protection Agency Clean Air Standards Act caught the domestic manufacturers off guard. GM, Ford and Chrysler had to expend large sums to not only downsize their fleets, but they had to make them pollute less. As a consequence there was little innovation. Corporate leadership and management failures resulted in products that were poorly received by potential customers. Labor - management discord

resulted in further problems and expensive labor contracts. The foreign share of the domestic automobile market grew from 6.1% in 1965 to 22.6% by the end of 1979. At the end of 1989 the import share of the U.S. automobile market was nearly 28% and rising.

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III. Auto Industry Contributions to War Mobilization

It is essential to examine the defense contributions of the American automobile industry to the war efforts of the United States if the national security significance of this industry is to be appreciated. Complete examination includes not only industrial capability but the political dynamics that exist in a democratic society with a free enterprise economy. The later point being no less important is not the primary focus of this paper. I will make reference to political and public policy only when germane.

Industrial capability is often cited as a critical element and a potent weapon in successfully prosecuting war. President George Washington said in his address to Congress in 1780 that "There is nothing so likely to produce peace as to be well prepared to meet an enemy." Yet America's industrial preparedness for war has had an inconsistent past.

World War I

The United States entered into World War I late and in theory had ample time in which to prepare. World War I introduced many new and sophisticated weapons into combat. America stood by in neutrality watching these developments take place on the battlefield. President Wilson had promised that the country would remain neutral and American business took the opportunity to supply both warring parties. Point of fact was that neutral America had exports of cars,

trucks, food and munitions to the belligerents totaling more than \$40 billion.¹ General Motors and other manufacturers used this windfall to nearly double automobile production capacity.

Corporate political dynamics within the automobile industry contributed to the nation's lack of industrial preparedness for World War I almost as much as national politics and deserves discussion.

The war in France did not affect U.S. automobile production in 1917 and in fact a record 1.9 million automobiles were sold at inflated prices to newly affluent Americans.² Henry and Wilfred Leland, the father and son team who founded the Cadillac Motor Company were devoted anglophiles and American patriots who wanted to produce badly needed airplane engines for the British. Cadillac Motors was acquired some years earlier by General Motors and production decisions were under the control of GM Chairman William Crapo Durant. The day after Congress declared war on Germany, Wilfred Leland went to see Durant in New York at GM corporate headquarters. Leland sought permission for Cadillac to build aircraft engines badly needed by the British. Durant refused saying, "this is not our war and I will not permit any General Motors unit to do work for the government."³

The Lelands were deeply offended and subsequently resigned from Cadillac on July 3, 1917 despite Durant ultimately reversing his decision and requesting the Lelands to remain at GM. In August 1917

the Lelands founded the Lincoln Motor Company and began producing 6,000 Liberty airplane engines. In September 1920, Lincoln produced the first Lincoln passenger car which was subsequently to rival Cadillac.

Henry Ford's patriotism was not much better than GM Chairman Durant's. In a New York Times interview in 1915 Ford was quoted as saying, "To my mind, the word 'murderer' should be embroidered in red letters across the breast of every soldier. Wars are the consequence of secret manipulation by moneylenders and munitions makers....Wall Street had a great deal to do with it."⁴

Henry Ford believed in peace and spent nearly \$500,000 maintaining his Peace Commission in Europe.⁵ He also financed newspaper advertisements attacking "preparedness" and "munitions interests" which he believed was motivated by excess profit made from supporting the war effort of Britain and its allies.⁶

February 1, 1917, Germany announced that it was resuming unrestricted submarine warfare. Henry Ford changed his antiwar stance and allowed Ford factories to produce war materiel. In addition to cars, trucks and the famous Model T ambulance, the Ford Motor Company was given a \$46 million contract to produce Eagle submarine chaser boats.⁷

The Eagle boat measured 204 feet in length and was manufac-

tured in Ford's new Rouge River plant with the American taxpayer picking up the \$3.5 million tab for widening and dredging the Rouge river. On May 7, 1918, Eagle boat #1 was launched from the first factory to produce a ship of its size on an assembly line from a completely indoor plant. The Rouge plant displayed the slogan "an Eagle a day keeps the Kaiser away" and a New York Times article about the plant was titled "Warships While You Wait."⁸

The Eagle submarine chaser program was not as successful as was popularly believed. By the time World War I was over only 7 completed boats were put into service of the 112 ordered. Ford blamed repeated specification changes from the boat's naval designers. However the real problem was difficulty adapting automotive assembly line techniques to shipbuilding in the time allotted.⁹

Prior to World War I the economy of the United States was sound and American corporate health was good. In 1913 a 1 percent tax was levied against the net income of all Americans. A graduated surtax on incomes above \$20,000 began at 1 percent and rose to 6 percent at amounts of \$500,000 or greater. The corporate tax rate was 1 percent of net income.¹⁰

After the outbreak of World War I the U.S. economy soured with resultant lower revenues from taxes and decreasing import tariffs. Individuals in Congress and government with a mind to prepare the nation for war knew that appropriations could not be cut and were

determined to increase defense spending. The first action to raise government income was the Revenue Act of 1916 which raised the individual and corporate tax rate to 2 percent. The surcharge upper limit was raised to 13 percent on income over \$2 million.

The projected deficit for fiscal year 1918 was estimated to be \$280 million. The Secretary of the Treasury recommended an immediate war appropriation of \$3.5 billion to finance the war. To do this the Emergency Revenue Act of 1917 was passed which amended the 1916 Act and raised the normal tax on individuals and corporations to 4 and 6 percent respectively. The surtax was graduated to a maximum of 63 percent of amounts over \$1 million and a war excess-profits tax was levied against "normal" profits of businesses in 1911, 1912 and 1913 and those of 1917.¹¹ At the end of 1917 Congress had appropriated \$19 billion. This amount included a \$7 billion loan to the allies. The new tax code was expected to cover about \$2.5 billion with the remainder to be deficit financed. By comparison, the entire cost of the United States government from 1797 to 1917, including four wars, had been \$26 billion.¹²

The contributions of the auto industry to American defense efforts in World War I were limited. American soldiers were equipped with mostly British and French weapons. There were 145 American made 75mm field artillery pieces shipped prior to armistice. One American anti-aircraft gun was made and no American made fighters or bombers were used in combat. A grand total of 16 U.S. produced

tanks were shipped overseas and a total of 107 of the 1741 steel ships ordered were completed.¹³

Despite the obvious advantages of entering the war late, the United States was not prepared to field or support a large scale war effort. The reasons were inadequate planning, lack of a defense department plan for organizing and equipping a large fighting force, and absent national mechanisms to control and coordinate the efforts of private industry. Historian George Lincoln summed up the principal industrial lessons learned from World War I to be:

1. Such wars require total economic effort
2. A war economy requires government control.
3. Careful allocation and adjustment is necessary to prevent shortages of critical items.
4. Economic interdependence with allies is inevitable.
5. The numbers and complexity of modern weapons require long lead time and expensive preparations.
6. Prior provisions of stores are necessary to support combat until new systems can be produced.¹⁴

National policy changes were implemented after the war to improve industrial preparedness. The National Defense Act of 1920 established the Industrial Planning Branch with the mission of developing plans for mobilization of industry to support wartime requirements. In 1922 the Army and Navy Munitions Board was established and in 1924 the Army Industrial College (later renamed the Industrial College of the Armed Forces to accommodate all branches of service) was founded to train officers for industrial mobilization and logistics.¹⁵

Unfortunately many of the industrial preparedness lessons learned after World War I became lessons lost. The Industrial Planning Branch produced several Industrial Mobilization Plans, none were ever implemented.¹⁶ Much of the industrial preparedness legislation passed after the war was overcome by increasing national concern with domestic issues and a renewed commitment to isolationism.

World War II

The beginnings of World War II witnessed Henry Ford again at the center of controversy. In 1938 Henry Ford was awarded the Grand Cross of the German Eagle, the highest award to a foreigner that Hitler could bestow. Ford was surprised at the widespread public outrage at his acceptance of Hitler's award. Ford maintained that the award came from the German people, who "as a whole are not in sympathy with their rulers in their anti-Jewish policies....Those who have known me for many years realize that anything that breeds hate is repulsive to me."¹⁷

Henry Ford and Charles Lindbergh publicly opposed aid or arms sales to Britain or France even after Germany invaded Poland beginning World War II. Henry Ford is quoted as telling a friend that "there hasn't been a shot fired....The whole thing has been made up by the Jew bankers."¹⁸ Edsel Ford, president of Ford Motor Company (Henry Ford's son) made public an agreement Ford Motor had with the British ministry of Defense to produce 9,000 Rolls-Royce Merlin engines for Spitfire fighters. Henry Ford held true to his promise and

reversed Edsel Ford's decision and refused to allow the Ford Motor Company to produce any war materiel.¹⁹ Henry Ford finally relented after the Japanese invaded Pearl Harbor and permitted his factories to produce needed war materiel .

The American automobile manufacturers were the largest defense contractors of World War II. General Motors was first with contracts totaling \$13.8 billion, Ford Motor was third with \$5.26 billion (second place was held by Curtiss-Wright with \$7.08 billion) and Chrysler was in 8th place with \$3.39 billion.²⁰ By July 1942, the entire U.S. auto industry accepted defense contracts equal to its annual peacetime production.²¹

Ford Motor Company's contribution to the war effort included jeeps, troop carriers, trucks, tanks, tank destroyers, Pratt & Whitney aircraft engines and gliders. Perhaps the most famous of Ford's contributions was from its Willow Run factory. In 1942, Willow Run was the world's largest industrial plant under one roof measuring greater than one mile in length. One complete Consolidated Aircraft B-24 bomber flew away from the plant's runway every hour.²²

Automobile production ceased at General Motors on 31 January 1942. General Motors was second only to E. I. du Pont de Nemours Company in spending for new factories and tools for war production. GM spent \$911 million for upgrading facilities with the U.S. government underwriting \$809 million of that with public funds. From these

new factories GM's Frigidaire and Saginaw divisions produced machine guns, Delco-Remy bomb fuses and Pontiac made anti-aircraft guns.²³

Perhaps the greatest shortage during World War II was manpower. Before 1940 GM employed approximately 240,000. By 1943 GM's employee roles stood at 460,000, with over a quarter of this number being female, e.g. "Rosie the Riveter." The requirement for "manpower" spread prosperity across gender lines to men and women who remembered the poverty and despair of the depression.²⁴

General Motors' Cadillac division manager Nicholas Dreystadt accepted defense contracts to produce aircraft gyroscopes. GM management was wary believing that such precision instrument production was very difficult and required technically skilled labor which wasn't available at GM. Dreystadt thought otherwise and machined a dozen gyroscopes himself and during the process, made a training film on how to make the instruments. In a novel approach to the hiring practices of the day, Dreystadt and his personnel manager hired 2,000 overaged black prostitutes and their madams who were willing to learn and work. Within weeks GM was turning out gyroscopes in quantities greater than set quotas.²⁵

It is estimated that 20 percent of all military hardware produced during World War II was produced by the U.S. auto industry.²⁶ A major departure from World War I was that U.S. allies ordered larger

and larger quantities of American made war supplies 2 years prior to the U.S. entering the war. Despite this fact, U.S. industry did not increase production capacity significantly until 1943. The bottom line was that even with a 2 year warning, U.S. industry required 2 to 3 years to reach full production.²⁷

Table 3-1

World War II Military Hardware Produced by General Motors²⁸

diesel engines for tanks and landing craft	198,000
aircraft engines	206,000
complete bombers and fighter planes	13,000
tanks, tank destroyers and armored vehicles	38,000
trucks and amphibious vehicles	850,000
howitzers	190,000
machine and submachine guns	1.9 mil
carbines	3.1 mil
bomb fuses	11 mil
mortar and artillery shells	119 mil
cartridge cases	39 mil

The required 3 year build-up time was the result of the government having neither prepared nor organized to dramatically increase production of war materiel. Hence, the mobilization of industry occurred piecemeal as was the case in World War I. In 1943, the Director of War Mobilization was created to give centralized control of the economy. This arrangement was very similar to the recommendations of the 1939 Industrial Mobilization Plan. Government actions to increase industrial production evolved from incentives to persuasion to regulation and finally, tightening controls.²⁹

Congress passed the National Security Act in 1947 establishing the Department of Defense. In 1949, Congress gave the newly created Secretary of Defense budgetary powers to adequately plan and equip the nation's armed forces. After World War II concluded, consumer demand for goods persuaded the government to allow commercial business to convert much of the munition production capacity to consumer goods. The U.S. automobile industry responded by producing greater than 19.4 million passenger cars between 1945 and 1950.³⁰ Many government owned munitions facilities were improperly maintained because of inadequate funding. Thus industrial preparedness of the United States after World War II was better than in 1939, but still not adequate for war.³¹

Korean War

President Truman did not fully mobilize the nation for the Korean War. Instead, desiring a robust and growing economy, he declared a national emergency with a limited mobilization designed to prepare the country for not only the conflict at hand, but future warfare. President Truman established the Office of Defense Mobilization to coordinate the war efforts of all executive agencies.

The Defense Production Act of 1950 was passed after the invasion of South Korea. This legislation established the national policy objective to maintain the required military and economic strength to preserve peace. The Act empowered the government to establish priorities and an allocation system to expand production capacity

beyond civilian demands.

Through 1953 and the Korean War General Motors was the nation's largest defense contractor with contracts for \$5.7 billion in military orders.³² GM also was the sole supplier of trucks as well as light and medium tanks. Ford, Chrysler and American Locomotive were eliminated on the grounds that single source procurement was more efficient.³³ GM's Fisher Body division made turret lathes for the Defense Department in 1952 at nearly twice the cost of a competitive bid.³⁴ The other auto companies complained that GM was receiving preferential steel shipments compromising their ability to remain competitive.³⁵

In the early 1950's General Motors enjoyed nearly 50% of the domestic automobile market and maintained its near monopoly on defense contracts. In 1956, GM opened its long planned Research and Technical center. The center was composed of 25 buildings over 330 acres, employed 4,000 people and cost \$150 million. The major departments were engineering and management with 700 employees, nominal research with 1100 people and the styling department with over 1200 personnel.³⁶

Charles F. Kettering, GM's preeminent inventor and engineer feared that the new research center would be used more to develop technology than true research. He believed that the center's true aim was to make a quick buck rather than pursue long term engineering

investment. Unfortunately Kettering was right. GM's budget for research and development was \$20 million, less than 0.2 percent of sales. The research center was devoted primarily to styling and consumer niceties.³⁷

Future defense contracts would be dependent on electronics, computers and ballistic missile technology. General Motors while holding a monopoly on defense cost-plus contracts, would have to develop new technologies to satisfy national defense product demands. Ultimately, GM (as well as Ford and Chrysler) decided to pursue the lucrative consumer market enabling smaller firms, both automotive and non-automotive to pursue high technology electronic, computer and ballistic missile defense related manufacturing.

In the 1970's and 80's the "Big Three" attempted to reverse their collective high-technology oversight by acquiring and integrating high-technology companies.¹ Being competitive for defense contracts was not the sole driving force. The American auto industry realized that modern products, both consumer and defense, rely heavily on leading edge technology and the manufacturing ability to rapidly convert technology to application.

1. General Motors acquired Electronic Data Systems and Hughes Electronics; Ford acquired first Philco electronics then a number of small aerospace electronics firms to form Ford Aerospace Corp; Chrysler acquired Gulfstream Aviation Corp.

It is obvious that the domestic automobile industry played a major role in all U.S. mobilizations. Interestingly, similar planning and coordination obstacles recurred with each mobilization despite legislative efforts to the contrary. Fortunately previous major U.S. wars afforded 2-3 years for American industry to retool and surge production to meet war demand. Future conflicts may occur abruptly with little time to convert and surge private industrial production to war requirements.

The U.S. auto industry has rapidly embraced "lean production" and "just-in-time" manufacturing processes to become profitable and more competitive.^{38,39,40} These trends along with a greater dependence on foreign suppliers for manufactured parts, assemblies and machine tools will greatly decrease America's ability to rapidly re-tool and produce war materiel on short notice.

The goals of private industry and democratic government are frequently disparate. Mobilization planning is essential for success in future wars and the primary element of mobilization is maintaining an adequate industrial base. The simple truth is, that America's industrial base as measured by manufacturing capacity is eroding. The domestic automobile industry was and is strategic to America's defense industrial base.

ENDNOTES

1. Cray, Ed. Chrome Colossus: General Motors and Its Times, p. 131.
2. Ibid., p. 155.
3. Ibid., p. 155.
4. Robert Lacey. Ford: The Men and the Machine, p. 142.
5. Ibid., p. 164.
6. Ibid., p. 164.
7. Cray, Ed. Chrome Colossus: General Motors and Its Times, p. 212.
8. Lacey, Robert. Ford: The Men and the Machine, p. 167.
9. Ibid., p. 167.
10. Bolling, Richard and Bowles, John. America's Competitive Edge: How to Get Our Country Moving Again, p. 141.
11. Ibid., p. 142-3.
12. Ibid., p. 144.
13. Gill, Timothy. Industrial Preparedness: Breaking with an Erratic Past, p. 4.
14. Ibid., p. 5.
15. Ibid., p. 5.
16. Ibid., p. 6. The Industrial Mobilization Plans met with heavy public criticism. Isolationist and pacifist groups went so far as to label these plans a blueprint for fascism.
17. Lacey, Robert. Ford: The Men and the Machine, p. 405. It is also interesting to note that Charles A. Lindbergh also received the Grand Cross of the German Eagle which he accepted from Hermann Goering in 1938.
18. Ibid., p. 406.

19. Ibid., p. 408.
20. Ibid., p. 409. Fortunately for Ford Motor Company the terms of World War II defense contracts were quite favorable. Ford was near bankruptcy during World War II after being subjected to the grotesque leadership of Henry Ford for the past decade. The Roosevelt government was considering nationalizing Ford to keep the industrial giant alive during the war.
21. Cray, Ed. Chrome Colossus: General Motors and Its Times, p. 318.
22. Lacey, Robert. Ford: The Men and the Machine, p. 410. In 1943, Chrysler took the honors for the world's largest plant. The Chrysler plant also produced aircraft and was larger than Willow Run.
23. Cray, Ed. Chrome Colossus: General Motors and Its Times, p. 318.
24. Ibid., p. 318.
25. Ibid., p. 319. The hiring of blacks for more than menial labor was still unheard of, even in Michigan. When Cadillac hired 2,000 black females to turn out gyroscopes Dreystadt had to endure protests and catcalls of "Nigger-lover" and "whoremonger." After the war ended, the United Auto Workers Union insisted that the women be fired, and they were. Some of the women reportedly committed suicide rather than return to the streets to make a living.
26. Ibid., p. 571n.
27. Gill, Timothy. Industrial Preparedness: Breaking with an Erratic Past, p. 7.
28. Ibid., p. 571n. These are figures that were presented in 1957 to the Senate Subcommittee on Antitrust and Monopoly in 1957 by GM president Harlow Curtice.
29. Ibid., p. 9.
30. Cray, Ed. The Chrome Colossus: General Motors and Its Times, p. 351.

31. Gill, Timothy. Industrial Preparedness: Breaking with an Erratic Past, p. 10.
32. Cray, Ed. The Chrome Colossus: General Motors and Its Times, p. 355.
33. Ibid., p. 354.
34. Ibid., p. 355.
35. Ibid., p. 394.
36. Ibid., p. 394.
37. Ibid., p. 357.
38. Warsh, David. The New York Times, 2 January 1991, p. F5.
39. Mandel, Michael. et. al. Business Week, No. 5192, 17 December 1990, p. 60-90.
40. Dertouzos, Michael L., et. al. Made in America, p. 95.

IV. The Machine Tool Industry

Machine tools bend, cut, and shape metal. They are the crucial building blocks for the metalworking sector of advanced industrial economies. Machine tools are vital elements in the technological revolution that is turning the vision of a fully automated factory into a reality. Virtually every article made of metal ranging from mammoth civil transport aircraft to minuscule industrial fasteners requires some type of machine tool for fabrication. Even the ubiquitous plastic part is formed in a complex steel mold or die which is made with machine tools. Excellent machine tools are a fundamental requirement for modern manufacturing regardless of the nature of the finished product.

U.S. Machine Tool Industry

The U.S. machine tool industry has encountered increasing competition from foreign producers both at home and in key export markets. Like the U.S. automobile industry, the domestic machine tool industry is in severe decline. In 1964 the U.S. was a net exporter and a world leader in machine tools; in 1986, 50 percent of domestic machine tool purchases were imported.¹ Production of U.S. manufactured machine tools is now only half of what they were at their peak.²

The pattern of decline for this key US industry rings a familiar tune. The Japanese have cornered the bottom of the market and the Germans are making inroads at the top.

US Balance of Trade in Machine Tools

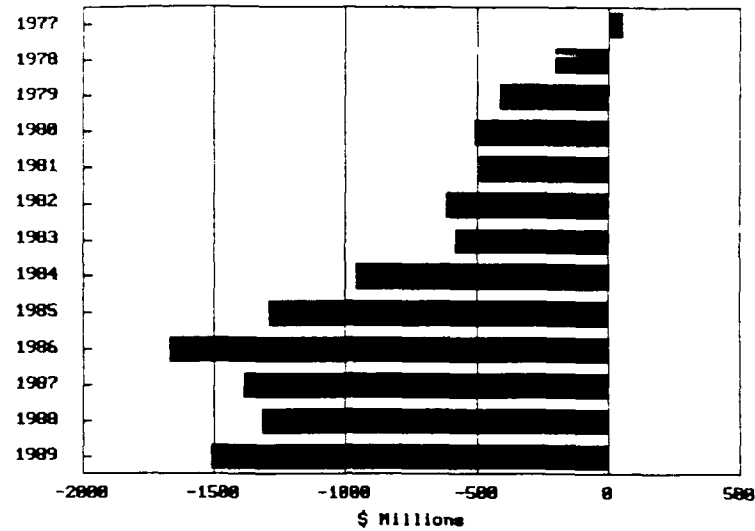


Figure 4.1 Source: NMTBA - The Association For Manufacturing Technology

The U.S. machine tool industry is fragmented, consisting of small family-owned firms situated in regions near user industries. Most firms produce highly specialized types of machine tools for a particular market niche or industry. U.S. firms built reputations on a specific model of machine tool and gained economies of scale by continuing production over many years. Extended production runs of a specific model of machine tool and the high cost of a user switching vendors, resulted in long product life cycles and discouraged innovation.

Consolidation of the U.S. machine tool industry has been occurring since the 1960s. Smaller companies were bought by larger firms, especially by large conglomerates. The purchasing conglomerates were motivated by short term strategies and the high profit margins of

machine tool makers during boom periods. Little commitment was demonstrated by large acquiring firms such as Textron. Instead of reinvesting in new products, profits were siphoned off for other corporate ventures. Low profit margin specialty tools were discontinued by the conglomerates, conceding these markets to overseas manufacturers. The domestic industry began concentrating on building high-volume standard products, eventually making machine tool producers vulnerable to competition from foreign manufacturers for basic machines.

US Machine Tool Purchases Imports as a Percentage

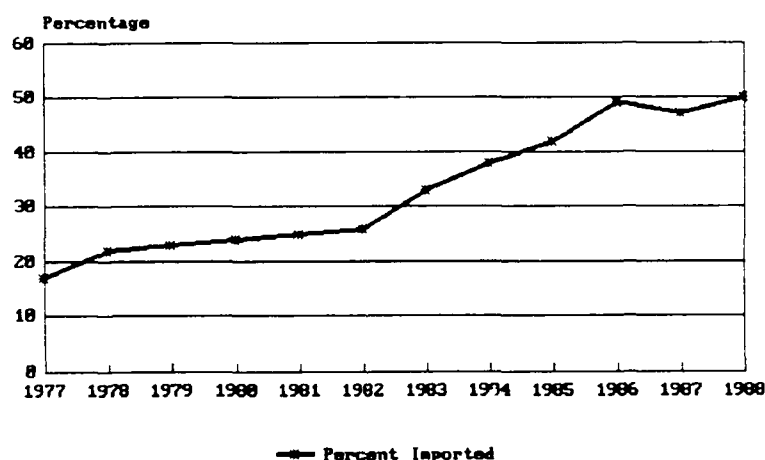


Figure 4.2 Source: NMTBA - The Association For Manufacturing Technology

By 1982, 85 percent of domestic machine tool production came from just 12 firms, and the numbers of active companies continued to steadily shrink with roughly 500 remaining today.³ Two-thirds of the surviving machine tool manufacturers have fewer than 20 employees.⁴ Some industry analysts believe conglomerate business practices are

primarily responsible for the near collapse of the U.S. machine tool industry. However, the causes of decline are multifaceted.

U.S. tool makers lost touch with their customers. The highly cyclic nature of the machine tool market resulted in periods of boom and bust. During boom periods, machine tool customers had to wait 18-24 months before delivery of orders. As profit margins for manufactured goods decreased, customers canceled orders for domestic tools, and later, bought cheaper imported tools rather than wait. Waiting for tool deliveries meant missing out on profits during periods of high product demand.

US Trade in Machine Tools Annual, 1977-89

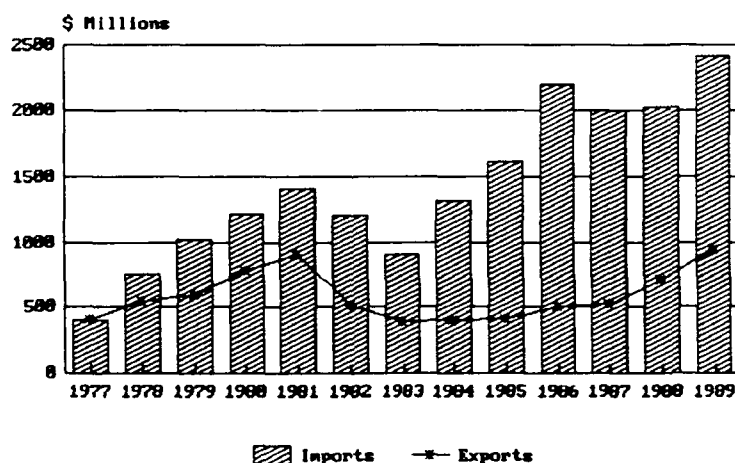


Figure 4.3 Source: NMTBA - The Association For Manufacturing Technology

This opening in the domestic market allowed foreign machine tool makers to demonstrate the flexibility, reliability and service to the

end-user after the sale of their equipment. Foreign machine tool makers were eager to work with the buyer to customize machine tools for specific needs. Most importantly, the machine tools were available in short order and less expensive.

U.S. tool makers and domestic industry failed to jointly develop new technologies and innovations. Relations between tool makers and end-user industries were driven by short term commodity strategies and an incredible lack of loyalty or appreciation of mutual interdependence. Machine tool purchasers, such as General Motors, drove hard bargains looking to purchase machine tools as cheaply as possible from any vendor, domestic or foreign. Antitrust laws precluded collaborative efforts in research and development or long term inter-industry planning.

There are also social and technological reasons for the decline of the U.S. machine tool industry. Less than 2 decades ago, the machine tool industry employed 115,000, now there are fewer than 58,000.⁵ It takes 4-5 years to properly train a machinist, yet there is not an organized apprenticeship program in this country. Vocational education in America is inadequate and, perhaps most significant, industrial vocations with uncertain employment futures are held in especially low esteem.⁶

Engineering curricula in the nations colleges and universities stress mathematics and abstract concepts rather than the science of

manufacturing. In American industry the awards and recognition are bestowed upon the engineers who create and design new technologies not new manufacturing processes.⁷

The American machine tool industry was slow to develop and adopt numerical control (NC) and computer numerical control (CNC) technologies. General Electric and Allen Bradley were the first American companies to incorporate NC and CNC controls for machine tools. These companies installed NC and CNC controls on complex, large and expensive machine tools. The complexity and expense of the machines dictated their being purchased by only large corporations. Because the machines were so complicated and did not make use of available microprocessors, they were unreliable and earned poor reputations. NC and CNC technology was then abandoned in the U.S. because of the expense of writing software and the cost of support to the too few customers who purchased these machine tools.

There was a significant technological success for the American machine tool industry. Under U.S. Air Force sponsorship, the Massachusetts Institute of Technology's (MIT) Servomechanisms Laboratory developed the hardware and software suitable for precision aerospace manufacturing of exceptionally complex parts. The Aircraft Industry Association adopted and institutionalized the MIT developments which enabled the U.S. aerospace industry to continue to be the world's technology leader. U.S. machine tool manufacturers were not attracted to scaled down versions of NC and CNC software suitable for simple

lathes and milling machines and the U.S. Air Force did not see its sponsorship role extending beyond aerospace manufacturing.⁸

Foreign Machine Tool Competitors

In 1985, Japan, West Germany, Switzerland and Taiwan accounted for 71 percent of the value of U.S. imports of machine tools including parts.⁹

The Japanese assault on the world machine tool industry was coordinated by the Japanese Ministry of International Trade and Industry (MITI). MITI encouraged the hundreds of small family firms to join larger companies. Companies were subsequently designated to specialize in various areas of machine tool manufacture such as lathes, grinders, milling machines, controls, etc. The net results of these orchestrated specializations were great savings of investment capital achieved through economies of scale and the development of industry standardization.¹⁰

In the early sixties, American manufacturers developed NC and CNC machine tools, but because of their high cost and complexity, found few buyers. The Japanese quickly developed smaller, more flexible NC and CNC microprocessor controlled machine tools at low prices. Japanese NC and CNC machine tools were aggressively marketed in the US at the lower price spectrum well before the Europeans or domestic manufactures could develop similar products. American tool makers responded to this challenge by conceding the

less expensive machine tool market to the Japanese without competing. As the Japanese gained a reputation for value, quality, and service, increasing their market share was easy. Now the Japanese are moving up-market into the more expensive machine tools. Interestingly, the prices of Japanese machines have not increased significantly despite a considerable decline in the international value of the U.S. dollar. Additionally, Japanese machine tool manufacturers have followed the lead of their auto industry colleagues and have assiduously invested in U.S. assembly plants, taking advantage of U.S. Free Trade Zone import tax laws. By the end of 1989 Japanese machine tool companies have built 10 plants in the US with intentions to build more.¹¹

Trade barriers in Europe kept Japanese machine tools from establishing much of a market there. MITI and the Japanese government provided covert subsidies to Japanese machine tool manufacturers to establish a market in the U.S.¹² The subsidies first granted tool makers were lucrative sugar import licenses. European rivals objected and the scheme was discontinued. MITI next gave government money gained from gambling on bicycle and motorbike racing. This second conspiracy was exposed by an American attorney. Ultimately it was revealed that MITI was funneling about \$1 billion a year in subsidies to Japanese machine tool makers to penetrate and sustain a presence in the U.S. machine tool market.¹³

In the low priced machine tool arena Japan is being challenged by other Asian manufacturers, notably Korea and Taiwan. Never stand-

ing still, Japanese machine tool makers are moving up-market, challenging the Europeans in the ultra-precision specialty machine market. Perhaps their most daunting challenge is the development and implementation of the flexible machining system (FMS). FMS systems are largely responsible for the success of "just-in-time" and "flexible-manufacturing" in Japan's auto industry. Japanese tool makers are equipping themselves with the same technology to find creative manufacturing solutions based on process capabilities and not product engineering.¹⁴

Europe's challenge to domestic machine tool makers comes principally from Germany and Switzerland. Germany's tool makers dominate the high-end of the market with sophisticated specialty equipment. German tool makers control 50% of the world market in gear cutting, a third in grinding, and a third in metal-forming.¹⁵ German domination in these markets continues, however they are feeling the pressure from relentless Japanese manufacturers.

Most German machine tool makers are mid-sized companies that are part of conglomerates. An interesting difference from their U.S. counterparts is that the parent company is often an engineering firm that has made an effort to integrate the tool maker into its total business. There is significantly less preoccupation with short term profit; importance is placed on technological leadership with a long term strategy to develop new products in conjunction with customer needs.

Germany has extensive and well established apprenticeship and vocational education infrastructures that produce skilled technicians. This system coupled with the practical engineering curricula at technical universities provides manufacturing expertise at all levels from the shop floor to product development laboratories. The technical professions, both practical and applied, are highly regarded, assuring capable aspirants who realize secure employment futures.

Europeans like Asians, understand that exporting is critical to economic survival. They believe it is vital to be knowledgeable of technologies and trends worldwide to stimulate innovation. Part of the European export strategy is to stay close to the customer and understand his needs. In some cases, this means establishing technical facilities or assembly plants overseas.

German and Swiss governments have not exercised the level of involvement in manufacturing as Japan's MITI. However, the European Research Coordination Agency (EUREKA) was established in 1985 with 20 members. EUREKA has committed over \$2 billion to 72 industrial R&D projects in the areas of electronics, factory automation and machine tools.¹⁶ The agency does not have its own research program, but provides financing for joint R&D projects conceived and managed by European companies and research establishments. The emphasis is on the development of commercially marketable technology.

The European Community Council has established two programs-European Strategic Program for Research and Development (ESPRIT) and Basic Research in Industrial Technologies for Europe (BRITE). ESPRIT was initiated in 1983 and focuses, in part, on the research areas of machine control systems and components of computer integrated manufacturing. The BRITE program was started in 1985 and includes pilot programs on automated materiel handling and assembly technologies.¹⁷

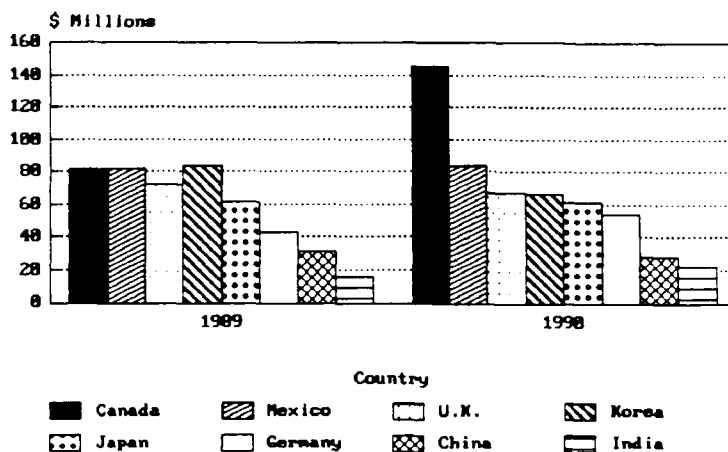
All told, it is estimated that over \$10 billion has been invested by the Europeans on machine tool R&D since 1970. The European Community in its Treaty of Rome, adopted legislation which exempted research and development cooperative agreements from antitrust restrictions up to the point of industrial exploitation of R&D results.¹⁸

U.S. Machine Tool Industry Forecast

The future of the U.S. as a manufacturing power in the world is clearly at risk. The erosion of the auto and machine tool industries are harbingers of American manufacturing ability in the future. A coordinated effort must be made to reverse the decline of these vital and strategic industries. Some small successes have been achieved in the past several years. These have occurred in well managed individual companies, and in focused areas of defense interest with government sponsorship. Overall the forecast for the U.S. machine tool industry remains uncertain at best, and in a worse-case analysis, dismal if rapid fundamental change is not implemented industry wide.

The recession of 1990 at first analysis seems to have passed-over U.S. machine tool makers. Orders for machinery and durable goods are up and the export demand for U.S. tools remains strong.¹⁹

LEADING U.S. EXPORT MARKETS Metal Cutting & Forming Machines



September year-to-date 1989 vs. 1990

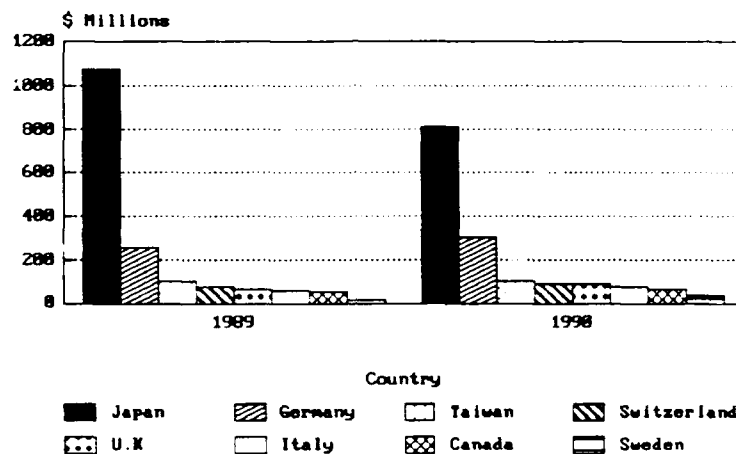
Figure 4.4 Source: NMTBA-The Association For Manufacturing Technology

The U.S. still has over a \$1 billion trade deficit in machine tools, but 1990's exports will probably exceed the \$1 billion record set in 1981.²⁰ The possibility of a world-wide recession is causing prices to soften, squeezing profits. If U.S. tool makers hope to remain competitive, they will have to maintain capital spending to keep their products innovative, cost effective and on target with end-user demands.

Net income for the industry has dwindled to 2.7 percent of sales in 1989 down from a high of 12.9 percent in 1980. The number of tool makers with 20 or more employees has fallen to 352 in 1987 from

469 in 1977, a drop of 25 percent.²¹ Present currency exchange rates offer some respite, however a revaluation of the dollar upward would almost certainly result in decreased U.S. tool exports causing further decline in the industry.

LEADING U.S. IMPORT SOURCES Metal Cutting & Forming Machines



September year-to-date 1989 vs. 1998

Figure 4.5 Source: NMTBA - The Association For Manufacturing Technology

Several U.S. firms have demonstrated the willingness to fight the foreign challengers and retake leadership positions and market share. Companies such as Cincinnati Milacron, Bodine Corporation and Monarch Machine Tool are striving to be first rate machine tool manufacturers with apparent success.²² Unfortunately for America, they represent the minority of domestic tool makers.

The success formula for American machine tool makers is not particularly complicated. Parent firms must understand that the

machine tool industry is a vital and strategic industry for the United States. Long term financial commitments must be made to develop products in close cooperation with customer product developments and requirements. U.S. manufacturers must become export market oriented, keeping abreast of foreign customer requirements, and willing to efficiently adopt and incorporate new technologies.

The prestige of manufacturing science and technical vocations must improve in the mind of the American public. Future machinists and manufacturing engineers must be able to look forward to secure and rewarding careers. These critical professions will ultimately determine America's place in world manufacturing capability. The United States will not be able to survive on a service economy alone as its sole source of international revenue as some have suggested.

The manufacturing requirements of an adequate national defense have, and will always have to be met by American industry if the U.S. is to remain a strategic world power. The Department of Defense has sponsored two recent efforts to help the machine tool industry. The USAF, through its Manufacturing Technology (ManTech) program, has promoted research in the manufacturing process rather than product development. ManTech's companion program, is Technological Modernization (TechMod), which provides financial aid to contractors who install advanced equipment. Both of these programs, while needed and welcome, are small in scale and too focused on defense needs, to benefit the machine tool industry significantly.²³

The National Machine Tool Builders Association (NMTBA) has provided funding for the National Center for Manufacturing Sciences (NCMS) located in Ann Arbor, Michigan. Membership includes more than 110 machine tool companies. The aim of NCMS is to set a national agenda for manufacturing research and then promote dissemination and commercialization of results. Research will be conducted by groups of members, sometimes in collaboration with universities or other research institutions.²⁴ Unfortunately, funds of NCMS, Man-Tech and TechMod are privately generated and inadequate, and cannot begin to approach the government subsidies of MITI or the European Community.

A national industrial policy for commercial applications urgently needs to be formulated and implemented. This policy should encompass the broad spectrum of manufacturing requirements of the U.S. with respect to those industries deemed vital to the country's economic and defense survival. Adequate government coordination and funding for future research efforts between industry and graduate education is also essential. Government sponsored manufacturing programs in aerospace and defense specific manufacturing have been outstandingly successful. Commercial industrial success is no less important and should receive like support.

ENDNOTES

1. Dertouzos, Michael L., et. al. Made in America, p. 20.
2. Wrubel, Robert. Financial World, p. 34.
3. Dertouzos, Michael L. Made in America, p. 234.
4. Ibid., p. 234.
5. Guenther, Gary L. Machine Tools: Imports and the U.S. Industry, Economy, and Defense Industrial Base, p. 12.
6. Dertouzos, Michael L. Made in America, p. 240.
7. Ibid., p. 240.
8. Ibid., p. 239. The irony here is that with the advent of the powerful and inexpensive microprocessor (PC computers), CNC machine tools are available to the hobbyist for under \$2500. Again, all the tools are foreign made.
9. Guenther, Gary L. Machine Tools: Imports and the U.S. Industry, Economy, and Defense Industrial Base, p. 33.
10. Dertouzos, Michael L. Made in America, p. 241.
11. Wrubel, Robert. Financial World, p. 24.
12. Dertouzos, Michael L. Made in America, p. 243.
13. Ibid., p. 243.
14. Kramer, Farrell. Investor's Daily, p. 1.
15. Dertouzos, Michael L. Made in America, p. 244.
16. Downer, C. United States Department of Commerce, Interoffice Memorandum.
17. Ibid., BRITE/EURAM Executive Summary.
18. Ibid.

19. Schiller, Zachary. Business Week, p. 73.
20. Ibid.
21. Kramer, Farrell. Investor's Daily, p. 25.
22. Slutsker, Gary. Forbes, p. 312.
23. Dertouzos, Michael L. Made in America, p. 246.
24. Ibid.

V. Prognosis

The U.S. auto industry's slow response to foreign competition was rooted in arrogance, ignorance of manufacturing developments abroad, and perhaps, contempt for both customers and competition. After World War II there simply was no significant competition. Foreign factories in Europe and Japan lay in ruins. American autos and machine tools were the best there were, because they were basically all there were. The U.S. auto and machine tool industries squandered the time from the Korean War to the first oil crisis. Almost 25 years of technological lead-time that could have been devoted to product development and plant improvements.

It is common knowledge that U.S. manufacturing plants and facilities became, on average, the oldest in industrialized countries. Adequate capital was not invested in modernized equipment or in the people that operated the plants. Skilled labor was regarded as a commodity to be hired and laid off as demand for products went up and down. Traditionally, relationships between management and labor were adversarial with little product input being sought or accepted from labor.

Product developments and new technologies, some pioneered in the laboratories of Americas' auto companies, were not offered on U.S. automobiles for years after the foreign competition introduced them into the U.S. market. Technologies that we take for granted

today, such as disc brakes, electronic fuel injection, independent suspensions and anti-lock brakes were brought to America on foreign cars first.¹ When the American public acknowledged the lack of innovation with poor fuel economy and abysmal quality, they began buying foreign (Japanese) cars in ever increasing numbers.

Lessons Learned

Don Peterson recently retired as chairman of Ford Motor Company. Peterson was responsible for the comeback of Ford Motor Company with such excellent products as the Taurus/Sable, Escort and Lincoln Towncar. Peterson was also instrumental in formulating Ford's "Quality is Job 1" program with dramatic results. In an interview with Forbes magazine he listed the following reasons for the decline of the U.S. auto industry:

1. "Cult of personality management."
2. Cut-throat auto executive/management environment.
3. Failure to market innovations.
4. Slow, inefficient and expensive new product development.
5. "Whoops engineering": poor product development resulting in reliability problems with expensive in the field fixes.
6. Failure to develop new engines and drivetrains
7. Non-engineer top executives
8. Overall erosion of U.S. manufacturing capability.²

GM's new chairman, Robert C. Stemple, is an engineer. The first engineer chief executive since Charles Wilson in the 1940s. He has pledged to overhaul the company by streamlining operations, listening to customers and producing quality products. Stemple's strategy is to restore profitability in its North American auto group through aggressive marketing, product redesign and decentralized management. He has vowed to preserve GM's market share for the near future.³

Unfortunately, GM is the least efficient auto maker in the U.S. and losses for 1990 have totaled more than \$1.6 billion.⁴

The American automobile industry's decline has contributed to the decline of basic industry and basic manufacturing capacity in the United States.⁵ The decline of the automobile industry and basic manufacturing capability is also reflected in the dramatic involution of the U.S. machine tool industry.⁶

U.S. AUTO MARKET SHARE 1965

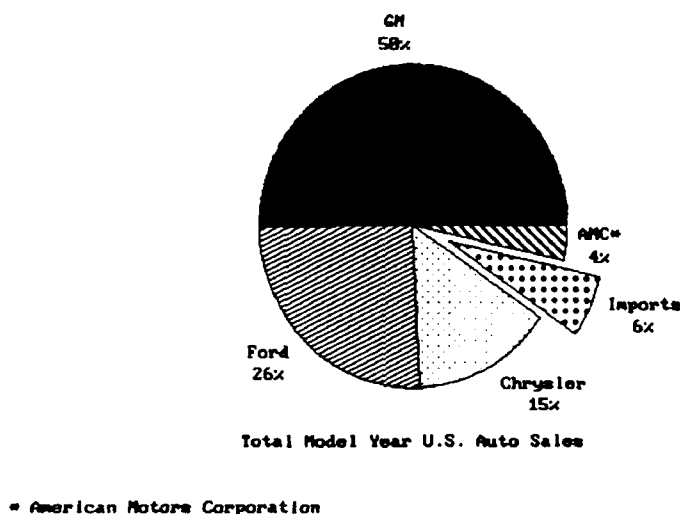


Figure 5.1 1965 U.S. Auto Market Share⁷

U.S. auto manufacturers are attempting to preserve market share by offering substantial rebates, long warranty coverage and improvements in product quality. What is needed in the long term is to relentlessly pursue quality, innovation and value for money.

The first lesson learned was that quality and reliability sell cars. Several isolated U.S. makes have proven that the product quality of domestic models can equal or exceed Japanese cars. However, the quality of domestic cars across the board is not yet equal to Japan. The lessons learned at such plants as Buick City in Flint Michigan need to be incorporated at other U.S. plants. At present U.S. cars rank second in overall quality to Japanese models but ahead of European makes.⁸

U.S. AUTO MARKET SHARE 1990

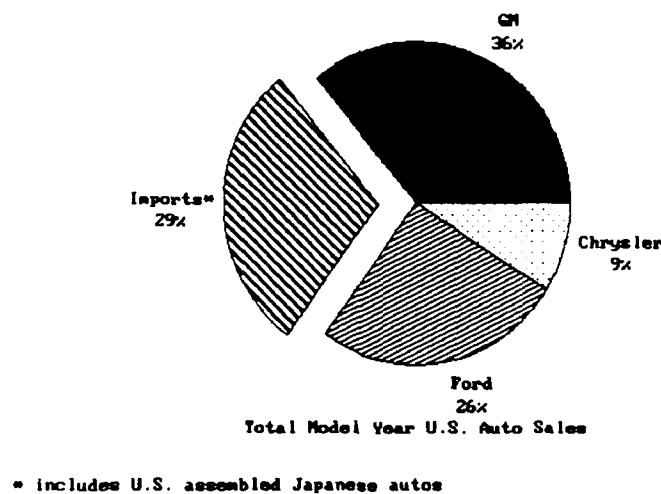


Figure 5.2 1990 U.S. Auto Market Share⁹

The need for an acceptable small car is well established. Ford had captured the small car sales prize with its Escort. In model year 1991 Ford introduced a new Escort. The new Escort borrows heavily

from Mazda to include the latter car's engine, drivetrain and chassis in toto. To date the new Escort hasn't sold as well as expected. GM has devoted almost \$4 billion to its new Saturn car company. The Saturn automobile is said to be a well executed small car design with average styling and a noisy engine.¹⁰ Thus far the reviews are promising. It has been said that if Saturn fails, GM may soon follow. The bottom line is clear that there is a market for a competent small car. The question is, can America produce such a car? Time will tell.

U.S. Auto Industry Prognosis

Chrysler Motors is in trouble again. Of all the domestic manufacturers, Chrysler has depended most on profit reducing rebate programs to sell cars. Chrysler has spent millions acquiring Maserati and Lamborghini as well as Gulfstream Aerospace. These acquisitions have not contributed to corporate profits, and may have prevented the company from developing a badly needed successors to its K-car chassis, a 20 year old standard sized truck design and the popular, but dated Jeep Cherokee model.

Chrysler is expecting an \$800 million negative cash flow this year. Presently the company has \$4.3 billion in cash reserves and is in much better financial condition than 1979. The Chrysler mini-van is the most popular in the U.S. with 45% of the mini-van market.¹¹ A new V-10 engined sports car, the "Viper" will be introduced in 1992 aimed at the Chevrolet Corvette. However, Chrysler must negotiate a new contract with the United Auto Workers (UAW). Ford and GM

recently signed contracts with the UAW that Chrysler's management says are too expensive.¹² A strike or an expensive settlement could spell disaster for Chrysler. Problems with leaks and seizures in the new Ultramatic transmission have seriously tarnished Chrysler's and Lee Iacocca's images. Chrysler's future is uncertain again because it veered away from its core business and neglected product development.

Ford Motor Company is this nation's most efficient auto maker.¹³ It has developed a line of quality automobiles and continues with product development. The introduction of 4.6 liter V-8, modular engine series for model year 1991 is hailed as a significant engineering accomplishment. Ford's vehicles over the past decade have led the domestic industry in both product concepts and execution. Ford's overseas divisions are profitable and there is a moderate amount of worldwide product integration.

Ford spent \$2.5 billion acquiring Jaguar motors. The reasons given for buying Jaguar was that an international symbol for luxury and quality was needed to round out Ford's product mix. Unfortunately Jaguar has not developed substantially new models and there are only concepts for new cars on the drawing boards. Developing a new product line for Jaguar will cost Ford an estimate \$2 billion.¹⁴ Money that may be better spent to develop new domestic and European models as competition and technical challenges become tougher. Ford will remain a viable manufacturer if it continues the quest to introduce new

quality products. An innovative, competent replacement for the Taurus/Sable mid-sized sedans badly needs to be brought to market. The current vehicle is going into its eighth model year and sales have slipped to second place, behind the new Honda Accord.¹⁵ Ford will have to husband its resources carefully and remain focused on its primary business.

GM has spent over \$50 billion during the 1980s acquiring Electronic Data Systems, Hughes Electronics and establishing the Saturn car company. GM is the least efficient auto manufacturer with an excess in manufacturing capacity.¹⁶ GM's market share has dramatically decreased from 50% in 1965 to 36% today. The quality of GM automobiles is both the best and worst in the industry. Obviously this inconsistency must be fixed. GM's overseas divisions are very profitable. GM has not successfully integrated innovations from its European automobile lines into domestic models and vice versa.

GM has introduced some of the largest cars in its history this fall. Introduction of these models couldn't be more poorly timed with the recent Persian gulf war and the increase in gasoline prices. As a consequence, these mammoth cars are not selling as well as anticipated.

GM has abandoned the heavy truck and bus market. The GMC heavy truck division was sold to Volvo and the Detroit Diesel engine division was sold to Roger Penske, Inc. In effect this leaves the U.S.

with one domestic city bus manufacturer. Many municipalities have resorted to purchasing foreign made public transportation vehicles.

GM has yet to produce a competent successful small car. The Saturn car division is an expensive attempt to break this trend. GM acknowledges its small car failures by not mentioning a Saturn - GM link in any of Saturn's advertising. Financial analysts have stated that the success of Saturn is a must for GM to remain viable in the future.¹⁷

Conclusions

Many arguments have been offered for the decline of U.S. manufacturing. The most popular were that foreign competitors were operating with labor cost advantages and subsidizing their products, ultimately "dumping" them on the U.S. market. There is some objective evidence to support these claims during the early years of the Japanese incursion into the domestic market.

The evidence also points out that the competition from Japan and Europe was sharply focused on specific market segments. Market needs and customer demands were clearly understood. Appropriate quality products with excellent after-sale service were developed and brought to market quickly. U.S. customers realized the value for money in these products and bought them. American manufacturers remained aloof from customers and allowed product quality to decline.

American manufacturers are largely to blame for the decline in U.S. manufacturing capability.

The specific reasons for U.S. industrial decline, in my opinion, are:

1. Expensive investment capital.
2. A long history of controlled or limited competition.
3. An adversarial management-labor relationship.
4. Industries that are paternalistic to customers.
5. Preoccupation with short-term corporate profits.
6. Failure to market innovative new products.
7. Failure to develop an acceptable, reliable small car.
8. The domestic auto industry senior executives are either managers or financial experts and not engineers.
9. An industry concerned with production quantities and profit margins with little or no attention to basic product quality.
10. The accepted notion that the U.S. economy is transforming into a "service economy" and basic manufacturing is not vital.
11. The lack of a national industrial strategy to guide private industry in support of national strategic commercial objectives.
12. Failure to invest in the worker's education and technical skills.
13. Decay of vocational education; absence of apprenticeship programs; university engineering programs preoccupied with the theoretical education, neglecting practical and applied engineering.
14. Lack of government sponsorship and coordination to develop advanced and expensive new commercial technologies.

Summary

The U.S. can compete as a major international automobile producer. Basic industrial manufacturing and automobile production are vital to U.S. strategic planning for both defense and commerce. The United States needs an industrial policy to preserve and encourage these vital industrial capabilities. Bringing technical innovations to market requires large sums of capital. Capital must be affordable and available for industry to compete with foreign competitors that are underwritten by their governments. Government consideration should be given to

provide industry incentives to produce and market new technologies. The U.S. will not compete in the world market place or remain a military power of significance as a consumer nation only.

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